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ABSTRACT

Thirty hearing-impaired children at a residential school for the deaf, a day school for the deaf, and a day program for the deaf in a regular public elementary school were shown picture books, asked to tell the story, and asked to respond to specific questions. Results showed that the ability to process questions was related to the structure of the information the respondent held. The ability to process simple identification questions was related to the presence of the response within the immediate environment, while the ability to comprehend questions involving predictions about events in a narrative not immediately present were related to the ability to retrieve the salient elements of the narrative. Questions involving the recall of detailed information or questions about causal relationships appeared to be dependent on the ability to retain more than the salient events of the narrative. It is concluded that simple linear curricula or testing procedures that are built on syntactic structures alone will not be accurate predictors of the hearing-impaired child's real ability or effective instructional devices. More global models of language development and processing are needed. (8 references) (JDD)

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The Relationship Between Knowledge of Story Structure and Question Comprehension in Young Hearing Impaired Children

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Paper presented at the annual meeting of
the American Educational Research Association,
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INTRODUCTION

Since questions must be asked about something, the child's knowledge of the topic is a factor in determining the accuracy of processing as much as the child's ability to parse the question. While earlier studies of children's processing of questions focussed primarily on the surface syntax of the question's form, more recent conceptualization of the comprehension of questions have proposed more elaborate descriptions which have included descriptions of the state of the respondent's knowledge of the world and the communicative situation (Lehnert, 1982).

Syntactic knowledge offers some predictability in the description of the sequence of question comprehension by young children. For example, "yes/no" questions would be prior to all other question forms (Limber) 1973). WH-questions such as "who, which," and "what" when they require a simple noun phrase response, such as an identification question, are comprehended earlier than questions beginning with "why" or "how" which often require an interpretation of the verb phrase (Ervin-Tripp, 1970; Limber, 1973). Nuclear "where" or a "where" which can be responded to with a simple action such as pointing or brief phrase may be prior to "what" in syntactically simple questions (Limber, 1973) although the Ervin-Tripp data did not appear to support that assertion (Ervin-Tripp, 1970). It further appears that interrogatives involving subjects are processed before those referring to objects (Tyack, 1974; Miller, 1974). Nominal marking question forms and concrete semantic marking would be prior in a comprehension sequence to verb markers and abstract semantic markers (Huttenlocher and Lui, 1979). Further extending the notion of the increasing complexity introduced by the verb phrase, we would expect that copula verbs followed by simple verb phrases followed by complex verb phrases would condition the syntactic, semantic and subsequently the processing complexity of a question. Since different combinations of features could easily be derived from this list, we would not expect a simple linear progression but rather clusters of questions which would be more or less difficult than other clusters.

The other major component of a system for processing questions and consequently for studying the comprehension of questions by young children would include some estimation of the degree of world knowledge that the interlocutor has. Story recall offers a useful model for studying the contribution of knowledge structure to question processing because it is highly predictable in its recall and shows definite developmental steps (Johnson, 1979; Geva and Olson, 1983). Nezworski, Stein, and Trabasso (1982) while reviewing previous research on story component recall argue that there is a standard pattern in recall with settings, initiating events, and consequences being retrieved more frequently while internal responses and reactions are least frequently recalled. They concluded that story grammars are a quasi-schema for generating story content in that the recall of any element of a story is a function of its relationship to a

superordinate goal.

In summary, syntactic rules are a device for describing structures, not a predictor of the intellectual demand of the question since the addition of semantic constraints primarily in the form of modals and tense differences can radically alter the cognitive demand of a particular question.

We hypothesized that two major factors would control a hearing impaired child's ability to process questions: the complexity of the question and the child's capacity to organize the information necessary to respond to the question. In the case of this study, the child's knowledge of story structure and the ability to impose a narrative organization was used as a measure of world knowledge. Children who are unable to recall related story elements should not be able to process questions more complicated than simple identifications. Children who can recall major adjacent story elements should be able to process questions about short term relationships. Finally, children who recall story structures should be able to process questions involving predictions.

METHOD

The study reported here includes the data from three years of a longitudinal study of young deaf children's ability to process manually encoded English questions. Data was collected at a residential school for the deaf, at a day school for the deaf, and at a day program for the deaf housed within a regular public elementary school. During the three years of the study, subjects were tested in the fall and early winter at all three sites. In addition to the testing procedures used, initial demographic information was collected from school records during the first year of the study.

Sample

The subjects for this study were 30 hearing impaired children at three separate sites. Due to the movement of some of the children and the discovery of secondary handicapping conditions among others, the final pool of subjects after three years was 25. The mean age of the students at the start was 5 years 5 months. 60% of the subjects were female. All had severe to profound hearing losses. Three of the children had deaf parents and were exposed to American Sign language at home; seven were exposed to some other form of manual communication at home; and the rest were spoken to at home. Two-thirds of the children were from single child families and 80% were the eldest child. None of the children were known to have any deaf siblings.

Intelligence was not normally distributed across the sample, ranging from 90 to over 120. There was a slight tendency to a brighter than average group. Because of the variety of intelligence tests used--the Hiskey-Nebraska, the Merrill-Palmer, and the WISC--as well as the difficulty of the reliable testing of young deaf children, the children were categorized as above normal or and IQ greater than 120 (three children); bright normals or children with an IQ

between 105 and 119 (seven children); normal (11 children) 95 to 104; and below normal, that is, below 95 (five children).

Data Collection

The stimuli for the testing situation were three cartoon story books which were sets of pictures without words: **Frog, Where Are You?**, **Frog Goes to Dinner**, and **The Great Cat Chase** by Mercer Mayer. The children were shown the books and then allowed to look at the books themselves. After the children had been through the books twice, they were asked by the interviewer to tell her the story. The interviewer then went through the book, picture by picture, while asking the children specific questions. The interviewers were two deaf female college graduates who were skilled signers and had experience in interviewing deaf subjects. The procedure was completed for a separate book on each of three separate occasions. The same procedure was followed each year.

To reduce frustration and fatigue, the questions were sequenced as much as possible from the least difficult to the most difficult within a book and only one book was tested during a testing period. Children were tested in their schools, either in their classrooms or in a nearby room within the school. Instructions to the interviewers were to attract the child's attention to the task, ask the question, and wait for a response. If the child failed to respond or gave an obviously wrong answer, the question was to be repeated.

The form of each question was a manual code on English where the interrogative adverb and the major question elements were signed along with appropriate facial expression and either the repetition of the question word or the use of the question sign at the end of the sentence.

The interviews were videotaped and transcribed by the interviewers.

Testing Protocol

63 questions were generated from a list of question forms developed on the basis of their increasing grammatical complexity. An attempt was made to distribute the question types evenly across the books, but this was not possible because of the differences in the content and the story structures of the three books. The confounding of the type of question and the book was more pronounced with the more difficult questions.

RESULTS

Analysis of Question Responses

The children's responses to the questions were coded using an eight level response code including correct responses.

Figure 1 Here.

Visual inspection of Figure 1 shows several patterns of question processing. The first group of questions are those

which were understood by most of the children from the very beginning of the study. These questions only require that children locate or label an immediately apparent object. The copula verb is semantically empty, thus these questions require a minimal amount of processing.

The second group of questions are similar to the first in that they require primarily a reference to the immediate context, however, they were not as well understood during the first year of the testing, but improved markedly by the second year. The most common feature of this set of questions is that they include "who". This would seem to suggest that "who" as a concept follows "what" and "where" in the children's ability to comprehend question forms.

The third category of questions which showed some improvement in the accuracy of the children's responses from the first year to the second year without showing additional changes into the third year also involved the recall of specific information. These questions are different from the second category in that they involve recall or prediction outside of the immediate temporal context. While their comprehension in year one is considerably lower than for the category two questions, both groups have about the same average gain in performance from the first to the second year, that is, both gain about twenty percentage points overall.

The fourth category of questions involved some kind of prediction about future events or a recall of higher level information. In either case, simple recall will not sufficiently answer the question. Like the other questions in groups two and three, the overall improvement in comprehension between the first and second years is about twenty percentage points overall with no substantive improvement by the third year.

The fifth category of questions could be grouped under the rubric of causal recall. Essentially they involve the retrieval of information that will permit the establishment of relationships between events. These questions showed no change between the first and second years, but showed a substantial improvement in the percentage of correct responses between the second and third years. Like the other question categories, the overall improvement was about twenty percentage points between years two and three.

The final group of questions showed virtually no change from year one to year three of the study. Two of the question types in this category involve predictions about information which may be outside of the story, that is, the retrieval would involve some kind of comparison with general world knowledge or may require a deeper grasp of the causal rather than the sequential relationships in the story line. These questions do not form as coherent a group as the other collections of question types.

If the above were summarized, we might produce the following sequence of comprehension of questions:

Identification

Recall of present data.

Recall of specific data.
Projections or predictions.
Recall of causal relationships.

To test whether or not these categories of questions do in fact form discrete groupings as described above, two repeated measures analyses of variance were computed. In the first ANOVA, the differences in response rates between the first and the second year were compared. In the second ANOVA the response rates for the second and third years were compared. This was done because some of the questions for the less difficult categories were dropped from the interview protocol between the second and third years. Since not all items were available across all three years, a single analysis was not possible.

In the first analysis the two factors of year and category of question type were compared. It was hypothesized that there would be a significant effect for both. Further, it was expected that the comprehension rates of the second, third and fourth categories would improve more than the other three categories.

In the second analysis, it was hypothesized that fifth category would show the greatest improvement while the third, fourth and sixth categories would not show any change. The first and second categories were not considered because individual items had been deleted in the third year of the testing.

For the first analysis, there was a main effect for the difference between year one and year two ($F=16.11$; $DF=1,23$; $p=.001$) as well as for the category of question type ($F=60.92$; $DF=5,19$; $p<.001$). The interaction between year and question type was also statistically significant ($F=5.19$; $df=5,19$; $p<.005$).

For the second analysis, there was no main effect for year, but there was a main effect for category of question type ($F=26.74$; $DF=3,20$; $p<.001$) and the interaction between year and question type ($F=5.68$; $DF=3,20$; $p<.01$).

Results of the ANOVA's as computed on the question responses showed a general pattern of responding over the three years of the study. During the first year, simple identification questions such as "What is that?" and "Where is that?" were most frequently responded to correctly. During the second year, it was apparent that three other general classes of questions were beginning to be correctly responded to including questions that referred to the present context, questions requiring a projection or prediction, and questions requiring specific recall from previous text. During the third year, the greatest improvement in question responding took place in the questions requiring the recall of causal relations. There was a change in the rate of responding across the three years for the question categories.

Analysis of Story Recall

Using Schank's (1982) system for organizing narratives

in memory, a story structure was derived for each of the three cartoon stories. The children's responses were then divided into propositions and assigned to one of the nodes of the story structure. A proposition was defined as a main verb and its arguments. Since copula verbs are not required in American Sign Language but are in manual codes on English, the issue of coding nouns and adjacent modifiers as propositions was resolved by applying the expected form for an American Sign Language production as the criteria for performance. This procedure tends to inflate the proposition count for children at the holophrastic stage, but on the other hand, it does not penalize children signing ASL or children influenced by ASL signers. A similar problem of inappropriate estimation of ability will arise in the question of using node summaries as opposed to a full recitation of details. Coding all propositions as equivalent in content density simplified the decision process for coding but may have resulted in underestimating the complexity of the information retained by the more able children.

The proposition coding process preserved the total number of propositions recalled, the sequence in which the propositions were recalled, and the salience of a node in the children's recall.

In Schank's dynamic memory theory (1982), a story proceeds through a series of reiterating elements or events, usually termed SCENES which involve a character or characters and an action. An action is interactive in that an action includes an activity and characters. An action may imply consequences which require a change in character role or in the action or in the location. It is this iterative structuring that gives forward motion to the narrative. Using Schank's descriptive system, the elements of the picture books were organized into scenes. Subjects' propositions were then assigned to each portion of the story structure implied in the progression of illustrations.

During the first two years of the study, the subjects recalled very little of the stories' content as seen by an average of 4.94 propositions recalled during the first year and 6.48 during the second year. However during the third year the number of recalled propositions jumped dramatically to 22.53 per story per child. Salient or unusual events tended to be recalled more than other events particularly after the first year. For example, children falling into the water is a salient event for five to seven year olds. Primary events, that is the opening and closing scenes of the narrative, were more likely to be recalled than scenes in the middle of the narrative. Within a scene, there appeared to be an order of scene parts. Actions were the most likely to be recalled; pre- and post-conditions were less likely to be recalled, and other scene elements were the least likely to be recalled.

Comparison of Question Processing and Story Knowledge

To test the relationship between the question category responded to and the knowledge of the story structure, a

Pearson Product Moment correlation matrix was computed for the number of propositions recalled by the child during one year and the child's percentage of correct responses for each of the six categories of questions described above. Because of the large number of correlations computed, the level of significance was set at .001 for this matrix. Given the power of this sample, a correlation which describes over 35% of the variance is required for statistical significance.

Table 1

Intercorrelation Matrix for Questions Categories and Total Propositions Recalled

Question Category	Year One	Year Two	Year Three
Identification	.230		
Recall of present data	.479		
Recall of specific data	.242	.454	.663*
Predictions	.400	.648*	.622*
Causal relationships	.098	.640*	.533
Miscellaneous	.257	.559	.514

Since simple identification and recall questions were generally well processed during the first year of the study and very few propositions were recalled, we can generally conclude that simple recall questions are independent of substantive story content recall.

During the second year of the study, the primary action of the story was most likely to be recalled by the children. The relationship between prediction and causal relationship questions and the total number of propositions suggests that the capacity to retain the primary elements of a narrative might be a factor in the ability to process questions requiring predictions or the recall of causal relationships. The correlation between prediction questions and recall of the primary action was statistically significant (r=.581) while it was not for the correlation between the ability to comprehend casual relationships and the recall of the primary action of the story (r=.468). Prediction questions appear to be related to the recall of the primary action of the narrative while questions which require a recall of casual relationships are better predictors of total content recall.

DISCUSSION

Since the initial speculation of this study that there would be a relationship between the quantity of a recalled narrative and the type of question a child was able to process was supported, a tentative sequence of comprehension would be:

Identification questions
Questions involving recall of present data

Retention of primary story action

Questions involving predictions

Retention of story detail
Recall of specific data
Recall of causal relationships

What is apparent from these results is that the ability to process questions is related to the structure of the information the respondent holds. The ability to process simple identification questions is related to the presence of the response within the immediate environment, however, the ability to comprehend questions involving predictions about events in a narrative not immediately present are related to the ability to retrieve the salient elements of the narrative. Questions involving the recall of detailed information or questions about causal relationships appear to be dependent on the ability to retain more than the salient events of the narrative.

The earliest research on the development of question processing by children focussed on the interrogative adverb. The limitation of surface, syntactic categorization of questions is that it misses the cumulative effect of the semantic, syntactic , and discourse elements of the question. At the syntactic level, the addition of modals or tense differences can radically alter the intent of a question. Surface syntactic descriptions of questions are useful for initially sorting questions into difficulty types, but they do not reveal functional processing differences. Some later work on child question processing included more elaborate syntactic categorizations of the question forms. However, this research suggests that semantic or discourse function categorization of children's questions will be more explanatory since to answer a question the data required for the response must in some way be present for the respondent.

A measure of the child's knowledge of narrative structure is a useful way of establishing the functional differences among questions when describing the development of question comprehension. In that sense, there appears to be three general types of questions: context dependent questions, salient event questions, and expanded content questions. Context dependent questions are those which can be answered from the immediate surroundings. Salient event questions are those which require at least a rudimentary knowledge of the overall narrative structure. Expanded content questions require a more elaborate knowledge of the narrative which itself is dependent on the knowledge of the salient events in the narrative.

A limitation of this study is that it was conducted using narratives as the basis for defining world knowledge. The recall of different forms of discourse may yield different types of question patterns. The general progression of the comprehension difficulty of the questions probably would not change, but it is quite possible that different discourse forms would be encoded in ways which would be related to a unique clustering of question types.

The implication of this study is that simple linear curricula or testing procedures for hearing impaired children that are built on syntactic structures alone will not be accurate predictors of the child's real ability or effective instructional devices. More global models of language development and processing are needed.

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Figure 1
COMPREHENSION RATE OVER THREE YEARS